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LECTINS AND THEIR APPLICATION TO PARASITOLOGY

LEKTİNLER VE PARAZİTOLOJİDE UYGULANIMLARI

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SUMMARY

This compilation deals with diagnostic applications of lectins in the taxonomy and identification of parasites. It was designed to emphasize the relationship between parasites and lectins by summarizing the studies based on determining general structural features of lectins, the virulence of parasites and distinctions among different categories of parasites.

ÖZET

Bu derlemede, lektinlerin parazitlerin taksonomi ve identifikasyonunda tanı amaçlı uygulanmasından sözedilmiştir. Lektinlerin genel yapısal özellikleri, parazitlerin virülansını ve parazit türleri arasındaki ayrımını ortaya koymada rollerine dayalı çalışmaları özetleyerek parazitler ve lektinler arasındaki ilişkiyi vurgulamak amaçlanmıştır.

Lectin, a word of Latin origin, is a substance which is not triggered by antigenic stimulations in the immune system and which combines with an antigen in a way resembling that of an antibody. Accordingly, it can be described as a substance which can agglutinate cells or precipitate glycoconjugates, with a structure resembling a carbohydrate binding protein or glycoprotein and is not of immune origin (1).

A lectin was reported to have at least two carbohydrate binding sections, and to have originated from plants, microbes and animals. However, it can also connect to surfaces not containing carbohydrates and to hydrophobic residues (2). It was stated in the bibliographical data that certain plant lectins can agglutinate various blood groups and erythrocytes, and are referred to as phytohemagglutinins (3). Many lectins inherit characteristics from plant seeds, skin, roots, fruit and leaves. Plant and animal lectins are classified according to their ability to bind carbohydrates. Thus, they can connect to:

(a) glucose-mannose; (b) galactose and N- acetly-D-galactosamine; (c) N-acetlyglucosamine; (d) L-fucose and (e) sialic acids (4).

Binding is reversible, and surfaces containing glycoconjugates are referred to as lectin reseptors (5). Lectin sensitivity was determined by means of hapten inhibition tests utilizing various sugars and saccharides. Their binding can be inhibited by one or more carbohydrates. All lectin molecules have two or more carbohydrate binding sections. These structures are responsible for storing and conveying carbohydrates (6).

Parasitology and lectins

There are considerable data related to interaction between parasites ranging from protozoa to metazoa and lectins. It was established with lectins that protozoa exhibit virulence variabilities according to surface antigen characteristics (4, 7).

That there is a structural resemblence between recently decomposed helminth type C lectins, playing a role in the host-parasite interaction, which is a subject that has been dwelt upon lately (8, 9).

Studies on defining the proteins of intercellular parasites using lectins of plant origin have now focussed on the synthesis of the proteins organizing the development of parasites (10).

Under the light of today's biotechnological developments, the use of lectins as biocontrol agents has gained importance. Considering the damage chemical pesticides cause to the environmental and public health, it can be expected that the areas of application related to the host- parasite interaction of environment friendly lectins will increase in the near future (11).

Parasite-lectin interaction and roles lectins play in the identification of parasites are reviewed below under the light of bibliographical data.

***Typanosoma* spp.**

It was asserted that *Trypanosoma lewisi* agglutinates with concanavalin A (con-A), soybean agglutinin (SBA), and wheat germ agglutinin (WGA). The reason for this reaction is the structures on the extracellular surface of the parasite resemble D-mannose, N-acetyl galactosamine, N- acetyl glycosamine and L-fucose (12).

It was expressed in recent studies that the distinction between *T. cruzi* and *T. rangelli* can easily be made by immunofluorescence. *Trypanosoma cruzi*can be distinguished from *T. conorhini*, which are non-pathogenic trypanosomes, by radioactive-marked lectins. It was also reported that tomato and ground-nut lectins were successfully used in the distinction of *T. conorhini*from *T. cruzi* and *T. rangelii,* and that *T. cruzi* reacted with fluorescein or colloidal gold-marked *Ricinus communis* and *Glysine maximus* lectins, but *T. rangelii* did not (4). Morover, it was asserted that lectins, which take part in the invasion of *T. cruzi*, developed different mechanisms during the combining of the parasite with the host cells of the amastigote and trypomastigote forms (13, 14). It was also reported that sites of combining with con-A located on the surface of *T. congolense*, which is another trypanosoma, were determined by SDS-PAGE, and that the surface proteins of the parasite contained D-mannocyl, D-glucocyl or N-acetyl-D-glucosaminoyl (15).

Mello et al. (16) asserted that a lectin isolated from *Rhodnius prolixus* could be effective on the life cycle of *T. rangelii*. It was expressed that carbohydrates on the surface of *T. rangelii* and *T. cruzi* cells,*Glysine maxima*and *R. communis* lectins, could be used in the determination of *T. cruzi* from the faeces of *Rhodnius prolixus* (17). It was further reported that con-A killed the procyclic forms of *T. brucei* which is another trypanosoma, by attaching itself to N-glycans on their surfaces (18).

***Leishmania* spp.**

It was asserted that surface carbohydrates of pathogenic and non-infective strains of *Leishmania enrietti* different from con-A were decomposed and promastigote A_1 and A_2 sub-serotypes of *L. enrietti* were defined by means of this lectin (19). The lectin obtained from *R. communis* was said to determine the difference among the same sub-species. It was also stated that *L. brasiliensis* failed to agglutinate in the presence of *R. communis*, but did so with con-A (20). It was asserted that ground-nut agglutinin was effective in the discrimination of the infective and non-infective forms of *L. major*, and that peanut agglutinin and SBA determined the difference between cutaneous and visceral *Leishmania* isolates. Hence, it was expressed that lectine binding property was variable in *Leishmania* species (21-27).

In a study carried out by King and Turco (28), it was reported that R2D2, which is a cell culture of *L. donovani*, selected to investigate resistence to cytotoxic lectin agglutinin, exhibited resistance to toxic effects of *R. communis* and thus R2D2 parasites had an ability to infect macrophages despite a deficiency of lipophosphoglycan.

Toxoplasma gondii

It was shown that fluorescein-marked con-A, WGA and SBA did not bind to the surface of *Toxoplasma gondii* trophozoites, but these fluorescein-marked lectins bound to bradyzoites settled in the brain of the parasite (4, 29, 30).

It was also asserted that certain lectins had a greater affinity to immunoglobulin M compared with other immunoglobulins. It was reported that lentil lectin (*Lens culinaris*) fluorescent conjugate was effective in determining *T. gondii* immunoglobulin M antibodies. It is believed that this property provides an advantage in the serologic diagnosis of acute toxoplasmosis (31).

Entamoeba histolytica

Virulence of the trophozoite form of *Entamoeba histolytica* depends on surface characteristics. It was shown that the strains isolated in amebic dysentery cases agglutinated with con-A, but strain isolated in aseymptomatic cases did not agglutinate with this lectin (4, 32). In a study related to the lectin stimulated agglutination of *E. histolytica* (33), it was asserted that *in vitro* agglutination of trophozoites belonging to three strains of *E. histolytica* cultured under

axenic conditions in the presence of con-A depended on con-A concentration and on the pathogenicity degree of test animals.

Cryptosporidium parvum

It was reported that tomentin, a lectin obtained from green water plant *Codium tomentosum*, and UEA-II obtained from *Ulex europeus* agglutinated *Cryptosporidium parvum* oocycts (34).

Giardia intestinalis

It was reported that WGA intensely agglutinated *Giardia intestinalis* trophozoites and cycts and stopped their *in vitro* reproduction (35, 36). Accordingly, it was concluded that food lectins could affect the course of giardiosis (37).

Trichomonas vaginalis

It was stated that con-A and WGA bound to the surface of *Trichomonas vaginalis* and agglutinated (38, 39). It was shown that WGA–binding reseptors were found in larger quantities in strains having higher pathogenicity (40). It was shown that while *R. communis* agglutinated a strain, SBA could agglutinate the other *T. vaginalis* (4). In another study (41); WGA, SBA, con-A, castor bean agglutinin (CBA) and garden pea agglutinin (GPA) were used in five different *T. vaginalis* strains. It was determined that the strains did not agglutinate with GPA; but agglutinated with CBA and SBA was weak, whereas all the strains strongly agglutinated with WGA and con-A.

***Acanthamoeba* spp.**

It was stated that *Acanthamoeba* was determined by calcoflour white and fluorescein-marked con-A, but only the cyst stage could be defined by calcofluor white (42).

Pneumocyctis carinii

It was expressed that *Pneumocyctis carinii* grown in rat lung and tissue culture reacted strongly to both con-A and WGA (4).

***Schistosoma* spp.**

Recent studies concerning *Schistosoma* showed that both con-A and WGA determined only adult stage of *S. haematobium*, but all parasitic stages of *S. mansoni* (4, 43).

General considerations and conclusions

The role of lectins in parasitology has been steadily increasing. Due to their general abilities to bind spesific glycoconjugates, lectins of plant and animal origin, have been used effectively with various organisms to correlate virulence with their surface properties. They may bind with receptors associated with their highest affinity.

As a result, making use of lectins in parasitology could provide certain advantages in routine diagnosis. Due their fixed structure, commercial feasibility, activity in small concentrations as well as their ability to distinguish the difference between various isolates, lectins are expected to have greater areas of application in parasitology in the coming years.

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